

## CLAIMS

What is claimed is:

1. A multiple speed power transmission, comprising:
  - an input;
  - 5 an output;
  - a first layshaft supporting a first pinion thereon;
  - a first power path for driveably connecting the input and first layshaft;
  - a first coupler for releasably coupling the first pinion and first layshaft;
  - a second layshaft supporting a second pinion thereon;
  - 10 a second power path for driveably connecting the input and second layshaft through a one-way drive connection,
  - a clutch for alternately connecting and disconnecting the input and the first power path;
  - a second coupler for releasably coupling the second pinion and second layshaft;
  - 15 an intermediate layshaft having a first gear secured thereto, the gear being in meshing engagement with the first pinion and the second pinion;
  - a speed reduction power path driveably connected to the intermediate layshaft;
  - and
  - a range coupler for coupling the output alternately to the speed reduction power path and the intermediate layshaft.
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2. The transmission of claim 1, further comprising:
  - a third pinion supported for rotation on the first layshaft and releasably coupled to the first layshaft by the first coupler;
  - 25 a fourth pinion supported for rotation on the second layshaft and releasably coupled to the second layshaft by the second coupler;
  - a second gear secured to the output in meshing engagement with the third and fourth pinion.

3. The transmission of claim 1, wherein:

the first power path comprises a third pinion secured to the input, and a third gear secured to the first layshaft in meshing engagement with the third pinion; and

the second power path comprises a fourth pinion driveably connectable to the input, and a fourth gear supported on the second layshaft in meshing engagement with said fourth pinion.

4. The transmission of claim 1, wherein the first power path produces a first ratio of the rotational speeds of the first layshaft and input, and the second power path produces a second ratio of the rotational speeds of the second layshaft and input that is less than the first speed ratio.

5. The transmission of claim 1, wherein the one-way drive connection is a member of the group consisting of a one-way clutch, a sprag one-way clutch, a roller-one-way clutch, a mechanical diode, and a hydraulically actuated friction clutch having an engaged state wherein the second layshaft and input are driveably connected and a disengaged state wherein the second layshaft and input are driveably disconnected.

6. The transmission of claim 1, wherein the speed reduction power path comprises:

a fifth pinion secured to the intermediate layshaft;

a fifth gear meshing with the fifth pinion;

a sixth pinion driveably connected to the fifth gear; and

a sixth gear meshing with the sixth pinion.

7. The transmission of claim 6, wherein the fifth pinion and sixth gear are alternately connected and disconnected by the range coupler to the output.

8. The transmission of claim 6, wherein:  
the sixth gear and fifth pinion are journaled on the first layshaft; and further  
comprising  
a third coupler supported on the first layshaft for alternately mutually  
5 connecting and disconnecting the first layshaft and sixth pinion.

9. The transmission of claim 6, wherein:  
the sixth gear and fifth pinion are journaled on the first layshaft; and further  
comprising  
10 a reverse pinion journaled on the first layshaft;  
a reverse gear meshing with the reverse pinion;  
a second reverse pinion driveably connected to the reverse gear, journaled on  
the second layshaft, and driveably connected to the fifth pinion; and  
a third coupler supported on the first layshaft for alternately mutually  
15 connecting and disconnecting the sixth pinion and reverse pinion to the first layshaft.

10. The transmission of claim 1, wherein the first coupler, second coupler,  
third coupler and range coupler are synchronizers.

20 11. The transmission of claim 1, wherein the first coupler, second coupler,  
third coupler, and range coupler are members of a group consisting of synchronizers  
and dog clutches.

12. The transmission of claim 1, wherein the clutch is a friction clutch.

25 13. A multiple speed ratio power transmission, particularly for motor  
vehicles, comprising:  
an input;  
an output;

a first layshaft supporting a first set of pinions thereon;  
a first power path for driveably connecting the input and first layshaft;  
a first coupler having a selectable coupling member supported for movement on  
the first coupler, the first coupler releasably coupling a pinion of the first pinion set  
5 and said first layshaft in response to movement of the coupling member;  
a second layshaft supporting a second set of pinions thereon;  
a second power path for driveably connecting the input and the second layshaft  
through a one-way drive connection;  
a clutch for alternately connecting and disconnecting the input and the first  
10 power path;  
a second coupler having a selectable second coupling member supported for  
movement on the second coupler, the second coupler releasably coupling a pinion of  
the second pinion set and said second layshaft in response to movement of the second  
coupling member; and  
15 an intermediate layshaft supporting a set of gears secured thereto, each gear of  
the set of gears being in meshing engagement with a pinion of the first pinion set and a  
pinion of the second pinion set;  
a speed reduction power path driveably connected to the intermediate layshaft;  
and  
20 a range coupler for coupling the output alternately to the speed reduction power  
path and the intermediate layshaft.

14. The transmission of claim 13, further comprising:  
a third pinion supported for rotation on the first layshaft and releasably coupled  
25 to the first layshaft by the first coupler;  
a fourth pinion supported for rotation on the second layshaft and releasably  
coupled to the second layshaft by the second coupler;  
a second gear secured to the output in meshing engagement with the third and  
fourth pinion.

15. The transmission of claim 13, wherein:

the first power path comprises a third pinion secured to the input, and a third gear secured to the first layshaft in meshing engagement with the third pinion; and

5 the second power path comprises a fourth pinion driveably connectable to the input, and a fourth gear supported on the second layshaft in meshing engagement with said fourth pinion.

16. The transmission of claim 13, wherein the first power path produces a  
10 first ratio of the rotational speeds of the first layshaft and input, and the second power path produces a second ratio of the rotational speeds of the second layshaft and input that is less than the first speed ratio.

17. The transmission of claim 13, wherein the one-way drive connection is a  
15 member of the group consisting of a one-way clutch, a sprag one-way clutch, a roller-one-way clutch, a mechanical diode, and a hydraulically actuated friction clutch having an engaged state wherein the second layshaft and input are driveably connected and a disengaged state wherein the second layshaft and input are driveably  
disconnected.

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18. The transmission of claim 13, wherein the speed reduction power path comprises:

a fifth pinion secured to the intermediate layshaft;

a fifth gear meshing with the fifth pinion;

25 a sixth pinion driveably connected to the fifth gear; and

a sixth gear meshing with the sixth pinion.

19. The transmission of claim 18, wherein the fifth pinion and sixth gear are alternately connected and disconnected by the range coupler to the output.

20. The transmission of claim 18, wherein:  
the sixth gear and fifth pinion are journaled on the first layshaft; and further  
comprising  
5 a third coupler supported on the first layshaft for alternately mutually  
connecting and disconnecting the sixth pinion and the first layshaft.

21. The transmission of claim 18, wherein:  
the sixth gear and fifth pinion are journaled on the first layshaft; and further  
10 comprising  
a reverse pinion journaled on the first layshaft;  
a reverse gear meshing with the reverse pinion;  
a second reverse pinion driveably connected to the reverse gear, journaled on  
the second layshaft, and driveably connected to the fifth pinion; and  
15 a third coupler supported on the first layshaft for alternately mutually  
connecting and disconnecting the sixth pinion and the reverse pinion to the first  
layshaft.

22. The transmission of claim 13, wherein the first coupler, second coupler,  
20 third coupler, and range coupler are members of a group consisting of synchronizers  
and dog clutches.

23. The transmission of claim 13, further comprising:  
primary pinion-gear pairs, the pinions of said primary pairs being supported on,  
25 and spaced mutually along the first layshaft, the gears of said primary pairs being in  
engagement with the pinions of said primary pairs, journaled on, and spaced mutually  
along the intermediate layshaft; and  
primary couplers connected to the first layshaft, each primary coupler having a  
selectable coupling member supported for movement on the corresponding primary

coupler, for releasably coupling a pinion of the primary pinion-gear pairs and said first layshaft in response to movement of said coupling member.

24. The transmission of claim 23, further comprising:

5 secondary pinions supported on, and spaced mutually along the second layshaft, each secondary pinion being engaged with a gear of a primary pinion-gear pair; and secondary couplers connected to the second layshaft, each secondary coupler having a selectable coupling member supported for movement on a corresponding secondary coupler for releasably coupling a secondary pinion and said second layshaft  
10 in response to movement of said coupling member.

25. A multiple speed ratio power transmission, comprising:

an input;  
a first layshaft;  
15 a second layshaft;  
a first power path for transmitting power between the input and the first layshaft, and producing a first ratio of a speed of the first layshaft and a speed of the input;  
a second power path for transmitting power between the input and the second  
20 layshaft, and producing a second ratio of a speed of the second layshaft and speed of the input; and  
a clutch for releasably connecting the input and the second power path.

26. The transmission of claim 25, further comprising:

25 a one-way drive connection between the second layshaft and input.

27. The transmission of claim 25, further comprising:

an intermediate layshaft driveably connected to the first power path and second power path;  
30 an output; and

a range coupler for coupling the output and the intermediate layshaft.

28. The transmission of claim 25, wherein:

the first power path comprises a first pinion driveably connected to the input,  
5 and a first gear supported on the first layshaft in meshing engagement with the first pinion; and

the second power path comprises a second pinion driveably connected to the input, and a second gear supported on the second layshaft in meshing engagement with the second pinion.

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29. The transmission of claim 28, further comprising:

a one-way drive connection between said second layshaft and the second gear.

30. The transmission of claim 28, wherein the first power path produces a  
15 first ratio of the speeds of the first gear and first pinion, and the second power path produces a second ratio of the speeds of the second pinion and second gear, the second ratio being less than the first ratio.

31. The transmission of claim 28, wherein:

20 the first power path produces a first ratio of a speed of the first layshaft and a corresponding speed of the input; and

the second power path produces a second ratio of a speed of the second layshaft and a corresponding speed of the input, the second ratio being less than the first ratio.

25 32. A multiple speed power transmission, comprising:

an input;

an output;

an intermediate layshaft;



primary power paths for driveably connecting the input and intermediate layshaft such that power can be transferred among the primary power paths without interruption;

5 a low range power path for driveably connecting the intermediate layshaft and the output;

a high range power path for driveably connecting the intermediate layshaft and the output at a higher output speed ratio than the low range power path;

a bypass power path for driveably connecting the input and the output such that power can be transferred without interruption between the bypass power path and the  
10 primary power paths with the lowest and highest speed ratios;

a range coupler for alternately activating either the low range or high range power path.

33. The transmission of claim 32, wherein the bypass power path produces  
15 an output speed ratio greater than the combination of any of the primary power paths with the low range power path and less than the combination of any of the primary power paths with the high range power path.

34. The transmission of claim 32, wherein the high range power path is a  
20 direct connection.

35. The transmission of claim 32, wherein the low range power path includes one or more pairs of meshing gears.

25 36. The transmission of claim 32, wherein the primary power paths include a common clutch, and power is transferred between two primary power paths by temporarily transferring the power to an alternate power path between the input and the intermediate layshaft.

37. The transmission of claim 32, wherein the bypass power path and a primary power path having a highest speed ratio include a common clutch, and power is transferred between the bypass power path and said primary power path having a highest speed ratio by temporarily transferring power to an alternate power path  
5 between the input and the intermediate layshaft.

38. The transmission of claim 32, wherein:  
a first primary power path has a lower speed ratio than a second primary power path;  
10 the bypass power path and the first primary power path include a common clutch; and  
power is transferred between the bypass power path and the first primary power path by transferring power to an alternate power path between the input and the output.

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